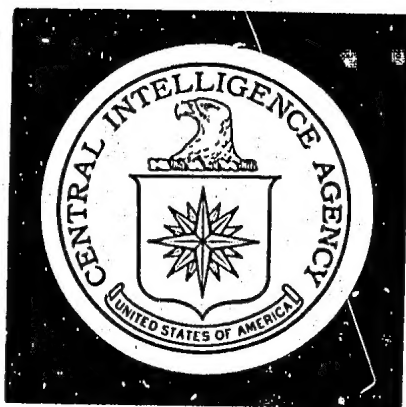


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DIRECTORATE OF
INTELLIGENCE

Intelligence Memorandum

India: Recent Trends In Foodgrain Production

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
April 1971

INTELLIGENCE MEMORANDUM

India: Recent Trends In Foodgrain Production

Introduction

1. Preliminary estimates indicate that India's foodgrain production during the year ending 30 June 1971 will reach a record 104 million tons, 4½ million tons more than last year. Four consecutive years of good weather since the droughts of 1965 and 1966 have provided favorable growing conditions for all foodgrains and for the spread of the new high-yielding varieties. Spread of high-yielding wheat varieties -- which have accounted for much of the increased output of foodgrains in recent years -- has slowed, however, as the "green revolution" has reached the limits of irrigated wheat land. Although the increase in rice output this year is impressive, weather has been the major factor as the area under high-yielding varieties of rice is still small.

2. This memorandum briefly reviews developments in India's foodgrain production since 1950. It analyzes recent trends, evaluates the role of government policies in recent and prospective developments, and discusses India's need for foodgrains imports over the short term.*

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DiscussionTrends in Production

3. During the 1950s, India's production of foodgrains (rice, wheat, coarse grains, and pulses) increased an average of 3.5% annually while the population grew about 2% annually. Roughly 40% of this increase came from expanded acreage and the remainder from greater yields, reflecting the results of increased irrigation, double cropping, and use of chemical fertilizers. The expanded acreage generally consisted of previously uncultivated land, some with new irrigation facilities. Still, during the decade, Indian yields remained among the world's lowest, and foodgrain imports -- averaging almost 3 million tons annually -- were essential to improve the very low food consumption levels. In India, foodgrains provide 80% of the calories and a major share of the protein in the diet.

4. In the early 1960s, foodgrain output stagnated. With nearly 80% of the farmland lacking irrigation, the monsoon's failure to arrive on time or with enough precipitation reduced not only yields (by 25%-30% for some crops) but also the area planted. A bumper crop of 89 million tons was achieved with exceptionally good weather in 1964/65,* but this was followed by two disastrous drought years when production fell below 75 million tons (see Table 1). By the mid-1960s the population growth rate had climbed to about 2.5% annually, adding about a million mouths a month, and per capita food availability declined sharply (see Figure 1). Concessional foodgrain imports were stepped up to a peak of 10.4 million tons in 1966 (see Table 2).

5. Since the droughts in 1965 and 1966, a combination of good weather and the spread of high-yielding varieties (HYV)** seeds have resulted in

* The crop year begins on 1 July of the first year and ends on 30 June of the following year.

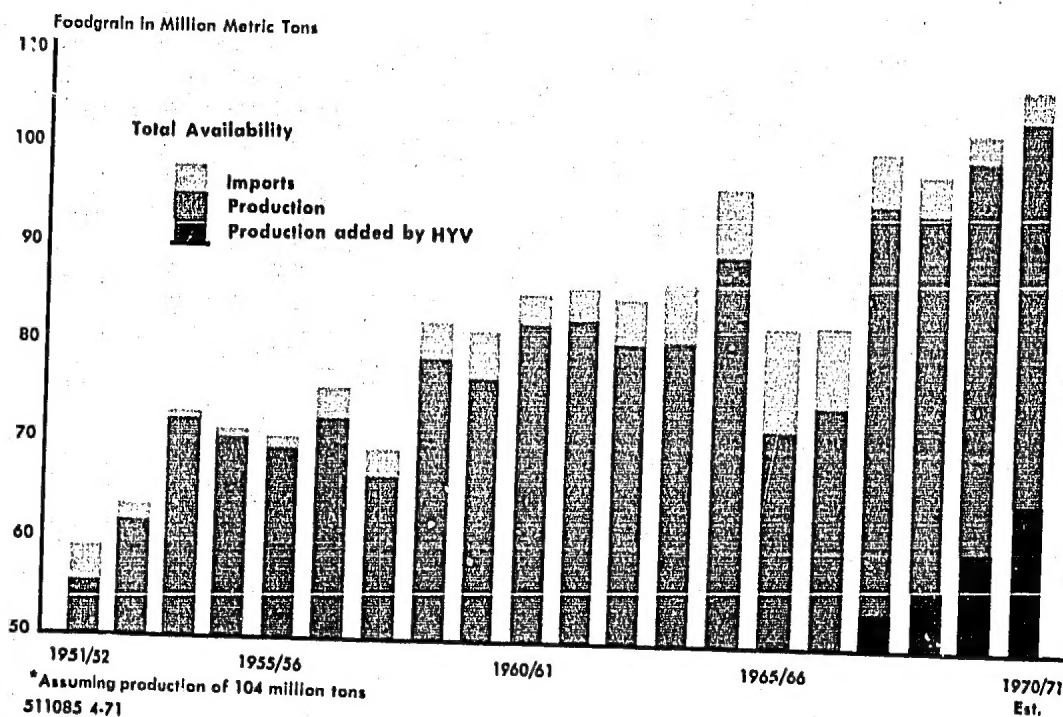
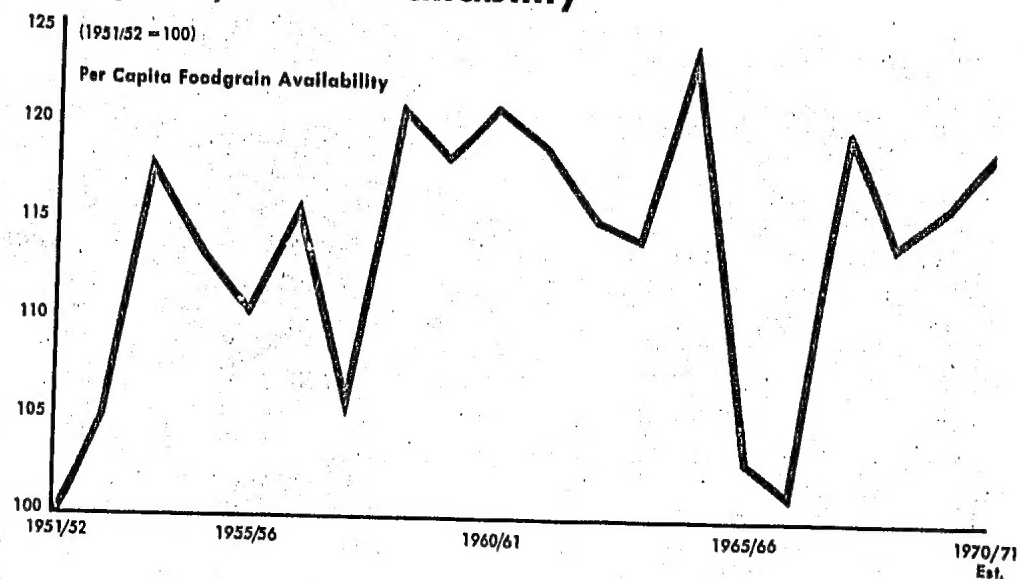
** The introduction of the so-called "miracle" or high-yielding variety of grains to India in 1963-65 brought great opportunity to improve grain yields. Although Indian researchers had already made some progress to improve yields, traditional varieties tended to grow taller when heavily fertilized and fall over, or lodge, as [footnote continues on p. 4]

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India: Foodgrain Production, Imports, and Availability

Figure 1



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some good increases in foodgrain production. Weather conditions were very favorable in 1967/68, the first year after the drought, and production was almost 6 million tons higher than the 1964/65 bumper crop -- a record 95 million tons. The next year had less favorable weather, and output dropped slightly to 94 million tons. With better than normal rainfall in 1969/70, output reached 99.5 million tons.

6. Weather conditions during the current crop year, which ends in June 1971, were excellent during the summer and fall for the major rice crop, but an exceptionally dry spell from October until late January adversely affected wheat and other winter crops (see the map, Figure 2). Moderate but highly variable rains during the last week of January and in early March, however, improved the situation in some areas. New Delhi estimates this year's total grain crop at 104 million tons,* or a 4.5% increase over last year. Nevertheless, four successive years of good weather and the HYV program combined will have succeeded in bringing the average growth rate up from a little more than 2% in the early 1960s to only about 3% since the drought, as shown in the following tabulation:

	<u>Million Metric Tons</u>		<u>Average Annual Rate of Growth (Percent)</u>
	<u>1967/68</u>	<u>1970/71</u>	
Rice	37.6	42.5	+4.2
Wheat	16.5	21	+8.4
Coarse grains	28.8	29	+0.2
Pulses	12.1	11.5	-1.7
<i>Total</i>	<i>95.1</i>	<i>104</i>	<i>+3.0</i>

the head grew heavy. The new varieties have short, stiff stems which permits them to be heavily fertilized and watered and to produce large heads of grain without lodging. The HYV also have a short growing season, making possible more multiple cropping.

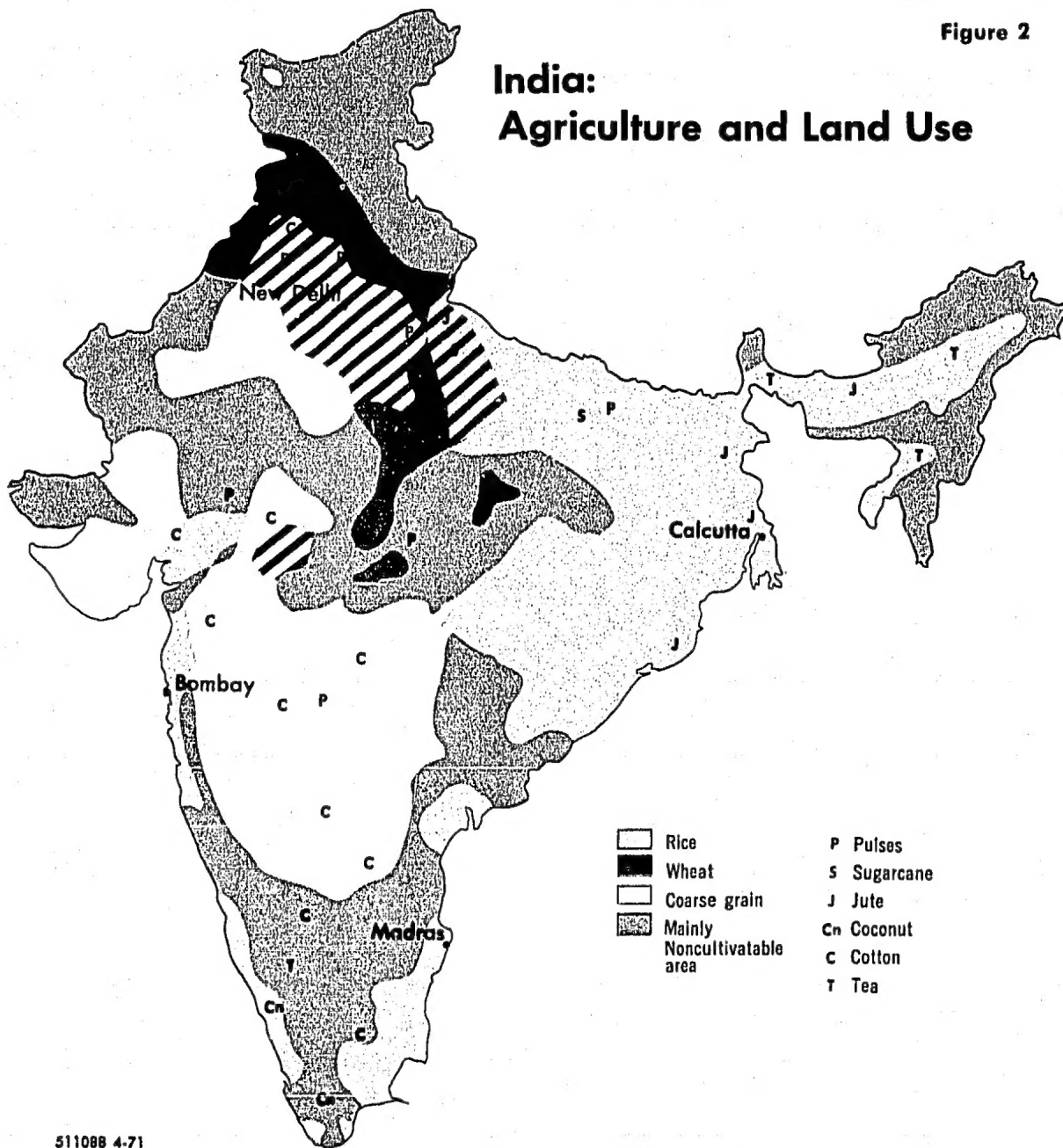
* India's President Giri stated in a speech to Parliament in late March 1971 that production would reach 105 million tons.

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Figure 2

India: Agriculture and Land Use



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7. It is quite possible that these early government estimates will be revised downward, perhaps by two million tons, especially since the indications are that fertilizer consumption again fell below expectations. A harvest of say 103 million tons would represent a 3.5% increase over last year and an average growth of only 2.7% since 1967/68. Moreover, output of coarse grains remained low in 1970/71 and a shift from pulses continued, making the Indian diet even more deficient than before in protein. It is likely that any reduction from the estimated 104 million tons will be mainly in these grains.

8. Recent efforts to increase output have centered on HYV seeds and the package of inputs needed to make them productive. Each year since the 1965-66 drought, HYV seeds have accounted for an increasing share of total production. After deducting for foodgrains that would have been grown on the land shifted to HYV, such seeds accounted for an estimated 4% of the total production in the first year after the drought, 6% in the second year, and 10% last year. The percentage may reach 15% this year. (The absolute amounts are shown in Figure 1.) Last year, HYV seeds were planted on about 31 million acres, or 10% of the total food-grain acreage (see Table 3). The spread of HYV acreage has slowed, however, and only about 3 million acres were added in 1970/71. After the initial jump in 1967/68 the program ran into difficulties that varied by crop, as discussed below.

Wheat

7. Wheat production increased from a high of 12.3 million tons before the drought to 20 million tons in 1969/70, accounting for about 75% of the increased output of foodgrains during that period. As a result, wheat's share of total foodgrain output increased from 14% to 20%. The increase in production resulted from increases in both acreage and yields, the latter resulting from the spread

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of HYV* and associated inputs -- mainly more fertilizer and improved irrigation from newly installed tubewells. Total wheat acreage rose from 37 million acres in 1967/68 to 41 million acres in 1969/70. Average wheat yields have increased by about 10% since the 1965-66 drought, as acreage devoted to HYV wheat increased rapidly from 1.3 million acres in 1966/67 to 16.5 million acres in 1970/71.

10. After the HYV spread to the major share of the irrigated wheat lands and to non-irrigated, rain-fed wheat lands, the growth of HYV acreage slowed sharply. Part of the increased acreage, moreover, was achieved by displacing coarse grains, pulses, and cash crops such as oilseeds and cotton as either the major or the second crop on irrigated land. The acreage of all of these crops has decreased since 1967/68 and their yields have remained low as wheat acreage has expanded. Farmers prefer to grow wheat because the new varieties are well suited to the Indian climate and the government has maintained the price high relative to other food-grains.

* The program to improve wheat output began in the early 1960s with the import and testing of the Mexican short-stemmed varieties. The grain was not fully suited to Indian tastes, but was acceptable and proved highly adaptable. These seeds were planted on 1.3 million acres in 1966/67, the second drought year. Subsequently, selection and breeding, including gamma radiation, resulted in amber colored varieties suitable for Indian consumers. Yields per acre in 1968/69 from the HYV seeds ranged from 2,000 to 5,000 pounds per acre, against an average of 1,000 pounds from the traditional varieties. Much research has been in progress to develop what are known as "3-gene" or "triple dwarf" varieties. A number of them are currently being tested. One triple dwarf variety, HIRA (HD-1941), was released for general cultivation in September 1970.

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Rice

11. The rice crop, now about 40% of total food-grains, increased much less than wheat in the past four years of good weather. Rice output in 1969/70 reached 40.4 million tons, nearly 3 million tons higher than two years earlier but only one million tons above the 1964/65 record crop. In the past two years, both the rice area and yields increased by less than 2% annually. Preliminary data for the current crop year -- with its excellent rice-growing weather -- indicate that the total rice area increased only marginally but that yields increased by 4%. As a result, production increased about 2 million tons to an estimated 42.5 million tons. Most of the increased yield is probably attributable to the weather rather than the spread of HYV seeds. The HYV rice was expanded to only another 700,000 acres this year for a total of 11.5 million acres -- about 10% of the total rice area. However, this represents about one-third of the rice area with some form of irrigation.*

12. Both technological and economic factors have slowed the spread of HYV rice. The major problem is that existing HYV rice seeds are not fully adapted to India's monsoon conditions. Their dense growth makes them very susceptible to disease and insects. Their yields are reduced by excess water, a situation typical of the gravity-flow paddy irrigation during the monsoon. Both of these factors are of considerable importance in the major rice-growing area in the Gangetic Plains and the southeastern coastal areas. As for economic problems,

* Official Indian statistics indicate that about 33 million acres of rice land were irrigated in 1966/67, as indicated in Table 3. It is not clear, however, how much of this land has irrigation water available only during one season, or water available for only one or two waterings in the event that a monsoon fails. Most of the irrigation systems are designed to permit the water to flow through a series of paddies, each lower than the preceding one. This type of irrigation does not permit sufficient water control for efficient use of HYV seeds.

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the early HYV rice was not accepted widely by consumers, who prefer non-glutinous and finer rice. Even more important, rice farmers generally have very small farms and are unable to invest in the required inputs. Intensive efforts to overcome at least some of these problems have been undertaken, including research and improved credit availability, but the impact thus far has been limited. There are indications, however, that a number of indigenous varieties (Jaya, Padma, and others), which combine high-yielding ability, resistance to local diseases, and excellent cooking qualities, are beginning to spread. These new varieties were released for cultivation in 1969 and 1970.

Coarse Grains and Pulses

13. Coarse grains (mainly sorghum, corn, and millets) collectively account for about 40% of foodgrain acreage but less than 30% of foodgrain output. In fact, output has actually declined since recovering from the 1965-66 drought. Acreage and yields were lower last year than two years earlier, but preliminary data indicate some recovery this year. These crops have suffered because only a small share of the acreage is irrigated, and wheat -- with a more favorable price -- competes for the best of the irrigated land. Indian researchers, aided by the Rockefeller Foundation, have developed hybrid varieties of corn, sorghum, and millets suitable to Indian conditions. Although some results are promising, cultivation of hybrid corn has been curtailed by the unattractive price and late maturity. Progress with sorghum has been limited by pest problems but that for millets is rapid.

14. The long-term downward trend in pulse production has continued. Neither acreage nor production has returned to pre-drought levels, and yields have risen only slightly. This decline is causing a deterioration in the diet, as pulses are the major source of protein. By official estimate, 80% of Indian children suffer from retarded growth, mostly because of a lack of protein. Pulses are not included in the HYV program, and only limited progress has been made in achieving genetic improvements. The decline in availability

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of vegetable protein might have been even greater if the US Agency for International Development were not promoting soybean production and research.

Government Policy

15. India's announced goals are 106 million tons of foodgrains in the current crop year and self-sufficiency in grains at the end of this calendar year. But to achieve this level, output would have to increase 6.5% over last year's level. This would put production back on the Five-Year Plan schedule after the shortfall of 2.5 million tons last year, the first year of the plan. The Five-Year Plan calls for an annual increase of about 5.7%. To improve agriculture and achieve these goals, the government has instituted a wide range of measures that began in 1965 -- a higher level of public investment in agriculture and irrigation, maintaining prices at incentive levels, providing more modern inputs to the farmers (chemical fertilizer, improved seeds, and insecticides), soil conservation, increasing double cropping in irrigated areas, improving storage, better transportation and more rural electrification, increasing research efforts to develop new seed varieties with special attention to dry land farming, and implementing a country-wide family planning program.

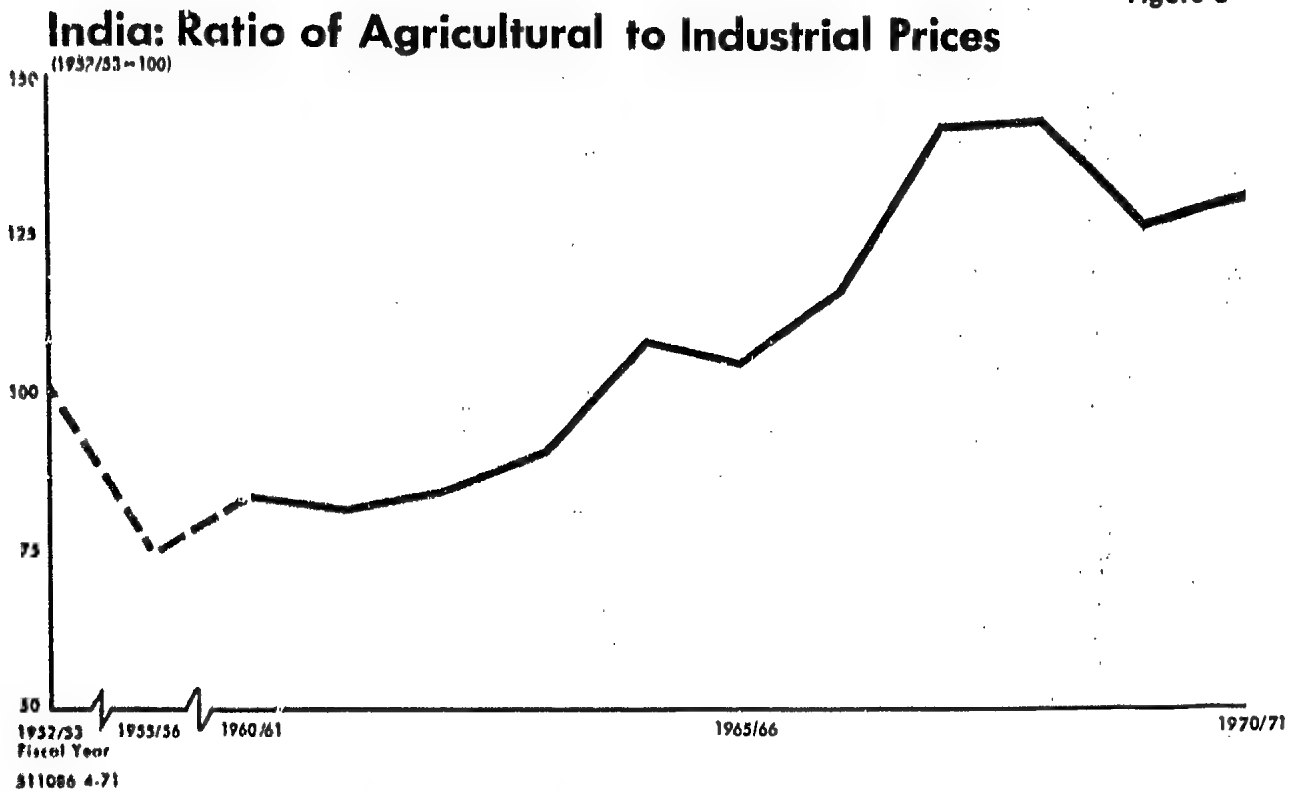
16. While there has been progress in each of these areas, the job remaining is massive. The government has made a good record at stabilizing foodgrain prices, but procurement prices have not risen as rapidly as the prices of manufactured goods purchased by the farmers. Thus the farmers' terms of trade are no longer as favorable as during 1967-69 (see Figure 3). The result has been a slower flow of private investment funds into agriculture.

17. From 1965/66 through 1969/70 the area under irrigation increased by about 3 million acres a year, compared with 2 million annually during 1950-65. Much of the recent increase has been small-scale irrigation in the wheat area. In 1970, there were about 370,000 tubewells -- triple the 1966 number -- and about 2 million diesel or electric pumps, compared with 980,000 in 1966. Even so, more than 80% of the cropped area still depended exclusively on rainfall, and rainfall in about 70%

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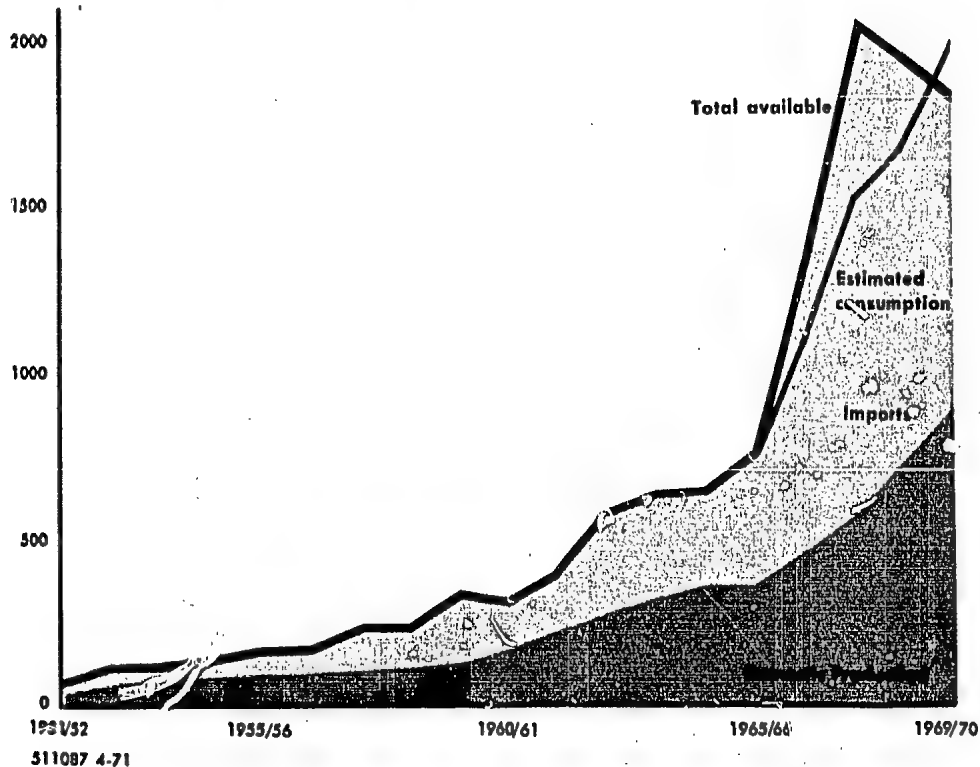
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Figure 3



India: Fertilizer Availability
(By Nutrient Content)
Thousand Metric Tons

Figure 4



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of the cropped area is too low and undependable to permit intensive cultivation even during the main cropping season. Lack of adequate water control in rice-growing areas and limited irrigation in areas growing wheat and other crops continues to be the major constraint.

18. Fertilizer consumption is increasing, but the pace has slowed. Compared with very high increases during the mid-1960s and with the Fourth Plan goals of 25% annual increases, consumption increased perhaps 18% last year and about 15% this year. The slowdown is due to such factors as a 10% excise duty on fertilizer imposed in March 1969, a lack of credit, inadequate distribution for all types of chemical fertilizers, and a lack of knowledge on the part of farmers. With consumption lagging, a stockpile of nearly a million tons has been built up and imports have been cut by some 40%, compared with the 1967 high (see Figure 4). But imports still accounted for half of the new supply last year and will have to continue as domestic fertilizer production is expanding too slowly to meet consumption requirements.

Conclusions

19. India's foodgrain production this year will likely reach 103 million or 104 million tons compared with 99.5 million tons last year. High-yielding wheat varieties have accounted for much of the gain in recent years, although rice has also accounted for a significant share of the increased output this year. HYV seeds, with yields much higher than local varieties, are now used on about 34 million acres, or almost half the irrigated foodgrain acreage. Despite the spread of HYV seeds and favorable weather for all foodgrains, production has increased an average of only about 3% a year since 1967/68 -- the first year following the drought -- somewhat faster than the early 1960s but slower than the 1950s. Per capita consumption is still below pre-drought levels, and the quality of the diet is declining as the output of pulses, the major source of protein, has declined.

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20. There are indications that the so-called "green revolution" in India has in some respects run its course, at least temporarily. The HYV wheat seeds are now used on virtually all irrigated wheat lands, as well as on some of the best irrigated land formerly used for coarse grains, pulses, cotton, and oilseeds. Future wheat increases, therefore, will come only by adding new irrigation facilities, increasing fertilizer application, or taking land from other crops. It appears, however, that newer HYV rice varieties have overcome some of the problems of earlier varieties -- lack of disease resistance and poor cooking qualities -- and are beginning to spread. Although much of the rice area has poor water control, these new varieties probably will spread gradually into areas with good water control.

21. Weather is still the unpredictable and most determining factor in Indian agriculture. Absolute declines in foodgrain output have occurred on the average in about one out of every three years since 1950.

22. Despite modest success in increasing output, foodgrain imports, including concessional imports, can be expected to continue. The census now underway will likely show the population increasing at a rate approaching 3%. With rising incomes also pushing up the demand for food about 1% per year, self-sufficiency is still an elusive goal. New Delhi has long been predicting that India will be self-sufficient in food by the end of 1971, but our projections of likely demand during the 1970s indicate that growth of production must accelerate to more than 4% annually -- on the average -- if self-sufficiency is to be achieved even in the 1980s.*

23. During the past four years of good crops, India has imported about 21.9 million tons of foodgrains, nearly 15 million tons under US PL 480. New Delhi usually connected these imports with the necessity to build a buffer stock, but in actuality the buffer stock was intended to reach only 5 million tons. This goal has now been filled, and with

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the Indian elections now over, Indian officials have already negotiated for additional concessional imports. Total foodgrain imports this year are expected to be at about 3 million tons, and PL 480 shipments are expected to be at least 2.3 million tons during the remainder of US fiscal year 1971 and fiscal year 1972.

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Table 1

India: Foodgrain Production

Million Metric Tons					
<u>Crop Year ^{a/}</u>	<u>Rice (Milled)</u>	<u>Wheat</u>	<u>Coarse Grains</u>	<u>Pulses</u>	<u>Total ^{b/}</u>
1949	25.11	6.76	18.77	10.02	60.65
1950	22.07	6.83	16.84	9.18	54.92
1951	22.62	6.34	17.44	9.11	55.51
1952	24.31	7.61	19.93	9.82	61.67
1953	29.79	8.11	23.19	11.11	72.19
1954	26.56	9.15	23.26	11.63	70.61
1955	28.67	8.87	19.99	11.69	69.22
1956	30.23	9.50	20.47	12.13	72.34
1957	26.54	8.01	21.86	10.10	66.50
1958	32.04	9.96	23.49	13.20	78.69
1959	31.69	10.32	22.87	11.82	76.70
1960	34.57	11.00	23.74	12.70	82.02
1961	35.67	12.07	23.21	11.76	82.71
1962	33.22	10.78	24.63	11.53	80.15
1963	37.00	9.85	23.72	10.07	80.64
1964	39.31	12.26	25.37	12.42	89.36
1965	30.66	10.42	21.15	9.80	72.03
1966	30.44	11.39	24.05	8.35	74.23
1967	37.61	16.54	28.80	12.10	95.05
1968	39.76	18.65	25.18	10.42	94.01
1969	40.43	20.09	27.29	11.69	99.50
1970 ^{c/}	42.05	21.0	29.0	11.5	104

a. The crop year begins on 1 July of the stated year and ends 30 June of the following year.

b. Because of rounding, components may not add to totals shown.

c. Preliminary.

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Table 2

India: Foodgrain Imports a/

Thousand Metric Tons

Calendar Year	Wheat	Rice (Milled)	Coarse Grains ^{b/}	Total ^{c/}
1947-50 ^{d/}	1,467	628	701	2,796
1951	3,064	761	976	4,801
1952	2,551	734	641	3,926
1953	1,711	178	146	2,035
1954	200	635	8	843
1955	442	269	--	711
1956	1,113	330	--	1,443
1957	2,898	748	--	3,646
1958	2,716	397	111	3,224
1959	3,553	295	143	3,991
1960	4,386	699	143	5,228
1961	3,092	384	134	3,610
1962	3,250	390	87	3,728
1963	4,073	483	61	4,617
1964	5,621	645	113	6,378
1965	6,583	783	229	7,595
1966	7,832 ^{e/}	787	1,780	10,399
1967	6,400 ^{f/}	455	1,882	8,735
1968	4,765	446	529	5,740
1969	3,090	487	295	3,872
1970 ^{g/}	3,250	220	--	3,570

a. Not including small quantities imported by the private trade overland from Nepal and some PL 480, Title II, imports from the United States.

b. Including corn imported from the United States under Title I by the All-India Starch Manufacturers Association.

c. Because of rounding, components may not add to totals shown.

d. Annual average.

e. Including 48,000 tons of wheat flour.

f. Including 52,000 tons of wheat flour.

g. Estimated.

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Table 3
India: Acreage Planted with High-Yielding Varieties of Seeds ^{a/}

	1949-72		Acreage in HYV				Preliminary 1970/71	Plan Targets 1973/74
	Total Acreage	Estimated ^{b/}	1944/47	1947/48	1948/49	1949/50		
Rice	22.1	22.0	2.2	4.4	6.5	10.9	11.5	22.8
Wheat	41.1	15.0	1.0	7.0	11.8	15.1	16.5	20.0
Other Cereals ^{c/}	116.8	9.4	1.1	3.2	4.6	5.1	6.0	16.8
Pulses ^{d/}	14.4	5.0	--	--	--	--	--	--
Total	295.4	61.2	4.4	14.7	22.9	31.0 ^{e/}	34.0	59.6
Annual Increase				+10.3	+8.0	+8.1 ^{e/}	+3.0	